

THE TRUE LARVA OF *HEXACYLLOEPUS*, WITH A
DESCRIPTION OF THE LARVA OF *H. FERRUGINEUS* AND
A SUMMARY OF RECORDS FOR THE GENUS.

(COLEOPTERA: ELMIDAE)

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ABSTRACT

The larva described in 1959 by Sanderson and Brown as that of *Hexacylloepus* was in reality that of *Microcyllloepus* sp. The true larva of *Hexacylloepus* has now been found in 18 localities in Oklahoma, Texas, New Mexico, Mexico, Grenada, Trinidad, Venezuela, Brazil, Paraguay, and Bolivia. It is described and figured. This larva is perhaps closest to that of *Stenelmis* in fundamental characters, but differs in a number of ways. Its most distinctive feature is the unusually long ninth abdominal segment, which superficially resembles that of larval *Dubiraphia*. Methods are suggested for insertion in existing keys by Bertrand, Hinton, Leech and Chandler, and Leech and Sanderson. Records of 5,268 *Hexacylloepus* adults and 57 larvae from 177 localities in 16 countries are recorded. The genus has not previously been recorded from the state of New Mexico in the U. S., nor from Bolivia, British Honduras, Colombia, Costa Rica, El Salvador, Honduras, Nicaragua, or Paraguay.

INTRODUCTION

In the spring of 1953, Milton Sanderson was working on a revision of the elmids of the United States. He was anxious to include a description of the larva of each genus, and he had succeeded in associating larval types with every genus then known in the United States except *Hexacylloepus*. As I was located within range of a possible collecting site, he enlisted my assistance. One specimen of *Hexacylloepus* had been found in Pennington Creek at Reagan, Oklahoma in 1937. I agreed to look for the larva, knowing only that it would probably be a tiny, worm-like creature a few millimeters in length, perhaps clinging to submerged stones.

In the summer of 1953 I undertook the search, and collected everything I could find that looked remotely promising. At the time I was teaching Field Entomology at the University of Oklahoma Biological Station, and the entire class joined the quest on a field trip. Upon receiving and examining our collection, Sanderson informed me that it included a specimen of what must be the larva of *Hexacylloepus*, and hoped that I might obtain more specimens. By October, I had sent him over a dozen, along with *Hexacylloepus* adults, numerous larvae and adults of *Microcyllloepus*, and assorted other dryopoid beetles. These provided the basis for inclusion of *Hexacylloepus* in the larval key in the revised edition of Ward and Whipple's "Fresh-water Biology" (Leech and Sanderson, 1959). In a joint paper listing known Oklahoma dryopoids, Sanderson described the larva of *Hexacylloepus* and I discussed the

ecology of the beetles covered (Sanderson and Brown, 1959). On this information, Bertrand (1965) amended his key to larvae of New World dryopoids, and has presumably incorporated this treatment of *Hexacylloepus* in his key to larval dryopoids of the world, which is now in press.

Meanwhile, I have become increasingly interested in dryopoids and have devoted most of my attention to them in the past 10 years. This has involved extensive collecting throughout much of the western hemisphere, and I have collected *Hexacylloepus* from Oklahoma to Brazil, often in considerable numbers. But I experienced repeated frustration in my attempts to distinguish the larvae of *Hexacylloepus* from those of *Microcyllloepus*, which almost invariably share the same habitat. For a while, I sorted them out with some degree of confidence—at least those from the United States—, but this was abandoned when a few living larvae identified as *Hexacylloepus* pupated and emerged as adults of *Microcyllloepus*. In other words, the larvae we happily assumed to be those of *Hexacylloepus* simply were not. For some years I have been on the lookout for the actual larva of *Hexacylloepus*. In the summer of 1971 I found a good prospect. During the autumn, on a rather extensive collecting trip in Central and South America, I obtained good corroboration. Then, upon re-checking other material, including unidentified larvae, I found that I already had a few on hand, some dating back as much as 10 years. To make it all the more embarrassing, some of these specimens were from Pennington Creek—carelessly misidentified not as larvae of *Microcyllloepus*, but as those of *Dubiraphia*. The larva, though in many fundamental characters quite similar to that of *Microcyllloepus*, bears a superficial resemblance to the rather bizarre, long-tailed larva of *Dubiraphia*.

I now have a total of 57 specimens of this larval type from 18 localities: 2 localities in Oklahoma, 1 in New Mexico, 3 in Texas, 2 in Mexico, 1 in Grenada, 1 in Trinidad, 2 in Venezuela, 4 in Brazil, 1 in Paraguay, and 1 in Bolivia. In all but 2 cases, the larvae were associated with adults of *Hexacylloepus*, and in these 2 cases adults were taken in nearby streams. Furthermore, there were present no other genera for which the larvae were unknown. The circumstantial evidence is thus quite convincing, although I have not reared larvae of this type and obtained adult *Hexacylloepus*.

Generic characters of the larva of *Hexacylloepus* Hinton

Body parallel, hemicylindrical (Fig. 1). Head when viewed dorsally exposed and not concealed by pronotum; anterior margin on each side between antenna and clypeus with an inconspicuous tooth (Fig. 2). Eye on each side consisting of a cluster of about 5 ocelli fused into a single compact unit. Antenna feebly retractile, 3-segmented; second segment longest; third segment shorter than first, slender and setiform, bearing a minute apical seta; alongside third segment and subequal to it in diameter but slightly longer is a blunt-tipped seta arising from apex of second segment. Maxilla with the palp 4-segmented; stipes not well differentiated into a palpifer; galea and lacinia separate, each bearing an apical cluster or tuft of heavy spines (Fig. 4). Labium (Fig. 5) subquadrate; palp 3-segmented; anterior angle of mentum with a relatively large mental palp or seta.

Posterior margins of both tergites and sternites and anterior margin of prothorax bordered by dentate tubercles bearing long, membranous setal tufts (Fig. 8-10).

Ninth abdominal segment conspicuously elongate, at least 3 times longer than wide, with a feeble longitudinal mid-dorsal carina, and with an arcuate apex (Fig. 1, 9). In some species there is also on each side a weak sublateral carina, giving this segment a pentagonal shape in cross-section. Ventrolateral margins bordered by a dense row of short, stiff spines of rather uniform length.

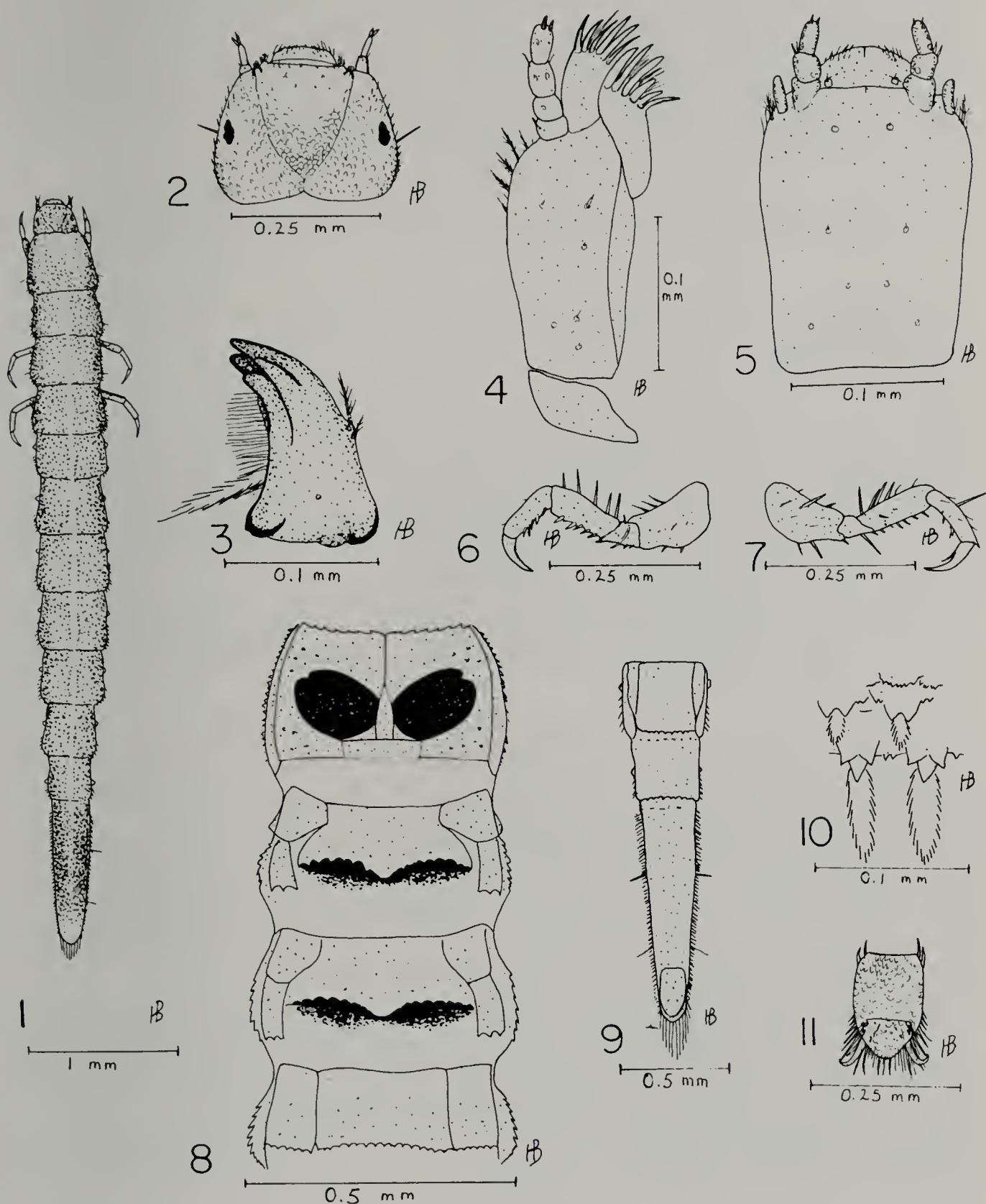


Fig. 1-11. *Hexacylloepus ferrugineus* larva: 1) dorsal aspect, entire; 2) dorsal aspect of head; 3) mandible; 4) maxilla; 5) labium; 6) front leg; 7) middle leg; 8) sclerites of thorax and first abdominal segment, ventral aspect; 9) abdominal segments 7-9, ventral aspect; 10) tubercles and tufted setae of second abdominal sternite near middle of posterior margin; 11) operculum of ninth abdominal segment, ventral aspect.

Operculum less than one-third as long as ninth segment (Fig. 9, 11), bearing a pair of long, recurved hooks attached to its dorsal surface and bordered posteriorly with rather long setae. With 3 tufts of long, filamentous, retractile anal gills.

Procoxal cavities closed and separated medially by a relatively prominent sclerite (Fig. 8). Prothoracic pleura undivided, those of the 2 sides meeting in the midventral line anterior to the coxae; posterior sternum broader than long. Meso- and metapleura each divided into 2 parts (Fig. 8). Abdominal segments 1-7 with pleura bounded by tergo- and sternopleural sutures; these sutures converge and meet on seventh segment (Fig. 9). Tuberculate spiracles present on mesothorax and first 8 abdominal segments.

Description of larva of *Hexacylloepus ferrugineus* (Horn) (Fig. 1-11)

In addition to the characters listed above, the larva of *H. ferrugineus* exhibits the following features:

Light grayish brown, darker on head and anterior part of pronotum; darkest on ninth abdominal segment, which is blackish brown except for testaceous apex. Sides of head pale around and behind eyes. Body with lighter patches on posterior portion of pronotum and on sides of mesonotum, metanotum, and first 6 abdominal tergites. These light areas feebly accented by small, diffuse, darker spots. Legs and antennae testaceous. Mouthparts testaceous to rufo-testaceous, the mandibles darkest.

Mid-dorsal line lighter in color, extending from pronotum to eighth abdominal segment, and bordered on each side by an irregular row of small, flat tubercles; light-colored area widest near middle of each segment except pronotum (Fig. 1).

Dorsum of head covered with flattened scales; lateral margin with anteriorly-directed setae, especially around eye (Fig. 2). Cuticle of body largely covered with flattened scales, rather sparsely intermingled with larger flattened tubercles, especially on the dorsal surface.

One mandible (Fig. 3) with 4 apical teeth, the shorter 2 rather blunt, the other 2 subacute; prostheca long and densely spinose; medial margin bordered with a rather dense brush of erect hairs or spines; lateral margin bearing 1 or 2 prominent, apically-directed plumose setae. The other mandible with 3 subacute apical teeth and a rudimentary fourth tooth.

Clypeus with a small tooth or projection on each angle bearing 1 or more tufted membranous setae. Fronto-clypeal suture visible in cleared specimens at high magnification. Labrum broadly arcuate, with an irregular basal row of brush-like membranous setae and sparse, small marginal setae.

Legs relatively slender and elongate (Fig. 6, 7); claws long, slender, with a small seta on inner margin.

COMPARATIVE NOTES

The adults of *Hexacylloepus* are probably closer to the genus *Cylloepus* than to any other genus in North or Central America, at least on the basis of external morphology (Hinton, 1940). *Hexacylloepus* adults are not very similar, either externally or internally, to *Elsianus*, *Microcylloepus*, or *Stenelmis*. The larva of *Hexacylloepus*, on the other hand, is strikingly

different from that of *Cylloepus*, more closely resembling that of *Elsianus*, *Microcylloepus*, *Neocylloepus*, or *Neoelmis* (Hinton, 1940; Brown, 1970; Sanderson, 1953-54). For example, it resembles each of these and differs from the larva of *Cylloepus* in exhibiting a posterior prothoracic sternum, in having meso- and metapleura divided into 2 parts, and in having abdominal pleura on only the first 7 segments; furthermore, the abdominal pleura are bounded by tergo- and sternopleural sutures which converge on the seventh segment. The body is also hemicylindrical rather than cylindrical in shape. However, the prothoracic pleura are undivided, as in *Cylloepus*. Other differences between the larva of *Hexacylloepus* and the larvae of any of these other genera are: (1) the unusually long ninth abdominal segment—3 to 4 times longer than wide—with its proportionately smaller operculum, which is only about half as wide and one-third to one-fourth as long as the ninth segment; (2) labial palp 3-segmented rather than 2-segmented; (3) one mandible with 4 apical teeth rather than 3 (difficult to observe); (4) the sclerite separating the procoxal cavities is unlike that of any of these genera.

In exhibiting a posterior sternum, meso- and metapleura of 2 parts, and pleura on the first 7 abdominal segments, the larva fulfills the predictions of Sanderson (1953-54) as to what the larva of *Hexacylloepus* would probably be like.

Perhaps the larva of *Hexacylloepus* is closest to that of *Stenelmis*, described as "larval type 5" by West (1929). It resembles the *Stenelmis* larva in having 3-segmented labial palps and undivided prothoracic pleura, as well as in the general nature of the sternites and pleurites, but differs in having an inconspicuous frontal tooth, a mandible with 4 apical teeth, a mid-dorsal line with associated tubercles, and the ninth abdominal segment conspicuously elongate with an arcuate apex and no apical spines or teeth.

ECOLOGY

Hexacylloepus appears to be characteristic of streams high in dissolved calcium content, especially those containing and forming travertine. Among the usual genera associated with it in such streams are the limnichid *Lutrochus* and the elmids *Microcylloepus* and *Neoelmis*. Less constantly associated with it are *Elsianus* and *Neocylloepus*. Adults are relatively conspicuous and often present in considerable numbers. In good habitats, I commonly collect only about 10% of the adults of *Hexacylloepus* and *Microcylloepus* taken in the net or observed upon stones removed from the stream. Larvae of *Microcylloepus* are abundantly present in association with the adults. This is not the case with *Hexacylloepus*, but I have not been able to determine just what the microhabitat is (hence the paucity of larvae, despite my careful search for them). The larvae I have knowingly collected were taken mostly from the undersides of travertine-covered rocks and pebbles, some in fast water only a few centimeters deep, others at a depth of almost a meter, in relatively slowly moving water just below a riffle. In the latter situation, they were accompanied by larvae and adults of *Dubiraphia*, and in all situations there were at least a few *Microcylloepus* adults and larvae. Nearby on submerged wood where *Microcylloepus* larvae were abundant I found no *Hexacylloepus* larvae, though adults were present. My reasoning that the unusually long ninth abdominal segment might be correlated with a more

elaborate set of anal gills, enabling the larva to subsist in slower and perhaps less oxygen-rich water appeared to be borne out rather well for *Dubiraphia* larvae, but seemed much less productive with respect to *Hexacylloepus*. As yet I have not discovered prepupal larvae or pupae, but it is likely that they occur in the crevices of moist travertine not far above the water level, or beneath somewhat loose bark or stones near the water.

SUMMARY OF RECORDS FOR THE GENUS *Hexacylloepus*

Published records of this genus, especially in the United States, are few and scant. In his description of *Hexacylloepus ferrugineus*, Horn (1870) indicated only that it had been collected by Belfrage in Texas. Brown (1956) listed this species from Johnston Co., Oklahoma, and Sanderson and Brown (1959) cited records of it from Murray Co. as well as from Johnston Co., Okla. Brown and Shoemaker (1964) added Bryan, Coal, and Pontotoc to the list of Oklahoma counties. Burke (1963) stated that *H. ferrugineus* was common in streams throughout the Balconian biotic province of Texas, but gave no further detail.

Table 1. Records of *Hexacylloepus ferrugineus* in the U.S. (numbers indicate localities, adults, and larvae respectively) [Total: 48, 3133, 18]:

NEW MEXICO: Eddy Co. (2, 20, 1).

OKLAHOMA: Bryan Co. (2, 19, 0); Coal Co. (1, 3, 0); Johnston Co. (8, 1379, 14); Murray Co. (4, 44, 0); Pontotoc Co. (1, 3, 0)

TEXAS: Bandera Co. (1, 2, 0); Blanco Co. (2, 12, 0); Coryell Co. (1, 82, 0); Edwards Co. (2, 94, 0); Hays Co. (3, 89, 1); Johnson Co. (1, 5, 0); Kerr Co. (2, 84, 0); Kinney Co. (1, 114, 1); Llano Co. (1, 4, 0); McCulloch Co. (1, 7, 0); Medina Co. (1, 12, 0); Menard Co. (3, 141, 0); Real Co. (3, 111, 0); Runnels Co. (1, 1, 0); Travis Co. (1, 5, 0); Uvalde Co. (2, 117, 0); Val Verde Co. (3, 558, 1); Zavala Co. (2, 92, 0).

Table 2. Records of Neotropical *Hexacylloepus* spp. (numbers indicate localities, adults, and larvae respectively) [Total: 129, 2135, 39]:

BOLIVIA: Dept. Santa Cruz (4, 16, 1).

BRAZIL: Dist. Fed. (5, 178, 0); State of Goiás (3, 16, 0); State of Maranhão (3, 10, 2); State of Pará (4, 90, 3); State of Parana (5, 23, 1).

BRITISH HONDURAS: (4, 13, 0).

COLOMBIA: Cundin-Amarca (1, 3, 0).

COSTA RICA: (6, 67, 0).

EL SALVADOR: (1, 4, 0).

GRENADA: (3, 14, 1).

GUATEMALA: (9, 40, 0).

HONDURAS: (2, 5, 0).

MEXICO (States): Chiapas (7, 24, 0); Coahuila (13, 809, 1); Colima (6, 69, 0); Guerrero (6, 32, 0); Jalisco (5, 196, 0); Morelos (3, 7, 0); Nayarit (1, 8, 0); Nuevo Leon (1, 1, 0); Oaxaca (1, 7, 0); Puebla (3, 27, 0); San Luis Potosi (7, 149, 0); Tamaulipas (2, 8, 0); Vera Cruz (2, 6, 0); Zacatecas (1, 30, 1).

NICARAGUA: (3, 12, 0).

PANAMA: (7, 15, 0).

PARAGUAY: (2, 5, 11).

TRINIDAD: (2, 99, 15).

VENEZUELA (States): Carabobo (1, 19, 2); Cojedes (2, 88, 1); Guarico (2, 28, 0); Portuguesa (1, 6, 0); Yaracuy (1, 11, 0).

In view of the paucity of records for the genus, it seems worthwhile for me to list at least a summary of my specimens, even though I have not yet had the opportunity to work with them at the specific level. As indicated in Tables 1 and 2, these records represent a total of 3,133 adult and 18 larval specimens from 48 localities in the United States and 2,135 adult and 39 larval specimens from 129 Neotropical localities. These specimens await further study in the Dryopoid Collection of the Stovall Museum of Science and History at the University of Oklahoma.

Modification of existing keys to include *Hexacylloepus*

Since Bertrand's (1965) modification of his key to include the larva of *Hexacylloepus* actually related to a species of *Microcylloepus*, the following change is proposed for his 1955 key. On page 135, delete from number 24 the parenthetical "*Stenelmis* auct." and insert a couplet as follows:

- | | | |
|------|---|-----------------------------|
| 24a. | Neuvième segment abdominal très allongé, sans dents postérieures | <i>Hexacylloepus</i> Hinton |
| 24b. | Neuvième segment abdominal non très allongé, avec dents postérieures bien écartées..... | (<i>Stenelmis</i> auct.) |

In the key given by Hinton (1940:230), change the lead number of the second choice for couplet 5 from 10 to 5a and add the following couplet:

- 5a. Ninth abdominal segment more than 3 times longer than
wide NORTH and SOUTH AMERICA
..... *Hexacylloepus* Hinton 1940
Ninth abdominal segment less than 3 times longer than
wide 10

In the key given by Leech and Chandler (1963:360), change the lead number of the second choice for couplet 21 from 22 to 21a and add this couplet:

- 21a. Ninth abdominal segment more than 3 times longer than wide; prothoracic pleura undivided; labial palp 3-segmented *Hexacylloepus* Hinton 1940
- Ninth abdominal segment less than 3 times longer than wide; each prothoracic pleuron divided by a suture extending laterally from procoxal cavity to margin; labial palp 2-segmented 22

In the key given by Leech and Sanderson (1959:1017-1018), modify couplets 69b and 70 to read as follows:

- 69b. Abdominal segments with flat tubercles which may or may not be arranged in rows 70
- 70a. (69) Last abdominal tergite (Fig. 38.85) slightly emarginate or straight at apex, and less than 3 times longer than wide; posterior margin of each tergite often with a pale spot at middle..... *Microcylloepus* Hinton
- 70b. Last abdominal tergite arcuate at apex and more than 3 times longer than wide; each tergite with pale median line broadest near middle rather than at posterior margin
..... *Hexacylloepus* Hinton

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